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Original Article

Use of ecological value analysis for prioritizing areas for nature conservation and restoration

Doğa koruma ve restorasyon öncelikli alanların belirlenmesinde ekolojik değer analizinin kullanımı

Simay Kırca, Hakan T. Altınçekiç

İstanbul University, Faculty of Forestry, Department of Landscape Planning and Design, 34473, İstanbul, Turkey

ABSTRACT

Many studies made in recent years revealed the fact that nature conservation and restoration practises have been required in our forests, whose natural structure has been degraded or destroyed by anthropogenic interference, containing a high level of biodiversity and situated in three different phyto-geographical regions. Considering the recent developments on these subjects mainly in Europe and North America, it is necessary to carry on nature conservation and restoration studies by applying different planning methodology for various landscape types. It was aimed with this study to develop a new planning concept for determining nature conservation and restoration priority areas based on the basic principles of "ecological value analysis", which is widely used today in many developed countries. Yedigöller National Park (Bolu) was selected as study area. Ecological value analysis was performed with the assessment of data collected from 80 sample plots related to 16 parameters, which are the rarity of plant communities and their spatial distribution, hemeroby degrees, diversity and rarity of plant taxa, endemic plant taxa, some components of forest structure (layerness, stand age, mixture type, mixture rate, canopy closure) and deadwood amount by using relation matrices and direct scoring. The results revealed that; (1) there is a rather variable landscape structure depending on naturalness, diversity of habitats, species diversity, rarity and endemism, (2) 90% of the study area has "medium" ecological value, (3) detailed ecological value scale scores ranges between 15-30, (4) anthropogenic disturbance is mainly determined in the area close to the lakes, (5) use of many parameters as possible considering the landscape structure improved the sensitivity of the analysis as well as providing the sophisticated analysis of the study area.

Keywords: Landscape planning, nature conservation, restoration, ecological value, land use

ÖZ

Son yıllarda yapılan birçok çalışma, üç fitocoğrafik rejyonda bulunup yüksek derecede biyolojik çeşitlilğe ev sahipliği yapan ancak doğal yapısı antropojenik müdahalelerle bozulmuş veya tahrip olmuş orman peyzajlarında doğa koruma ve restorasyon çalışmalarına gerek duyulduğunu ortaya koymuştur. Özellikle Avrupa ve Kuzey Amerika'da son yıllarda bu konulardaki son gelişmeler göz önünde bulundurulduğunda, çeşitli peyzaj tipleri için farklı planlama yöntemlerinin uygulandığı doğa koruma ve restorasyon çalışmalarının yapılmasının önemli olduğu görülmektedir. Bu çalışmada, doğa koruma ve restorasyon öncelikli alanların belirlenmesine yönelik olarak günümüzde birçok gelişmiş ülkede yaygın olarak kullanılan "ekolojik değer analizi"nin temel prensiplerine dayanan bir planlama konsepti geliştirilmesi amaçlanmıştır. Çalışma alanı olarak Yedigöller Milli Parkı (Bolu) seçilmiştir. Ekolojik değer analizi 80 örnek alandan toplanan bitki toplumlarının enderliği ve bunların mekansal dağılımı, hemerobi dereceleri, bitki taksonlarının çeşitliliği ve enderliği, endemik bitki taksonları, orman strüktürünün bazı bileşenleri (katlılık, meşcere yaşı, karışım biçimi, karışım oranı, meşcere kapalılığı) ve ölü ağaç miktarına ilişkin 16 parametrenin değerlendirilmesiyle ilişki matrisleri ve doğrudan puanlama kullanılarak gerçekleştirilmiştir. Elde edilen sonuçlara göre; (1) doğallık, yaşam alanı çeşitliliği, tür çeşitliliği, enderlik ve endemikliğe bağlı olarak oldukça değişken bir peyzaj yapısı vardır, (2) araştırma alanının %90'ı "orta" ekolojişk değere sahiptir, (3) ayrıntılı ekolojik değer skalası puanları 15-30 arasında değişmektedir, (4) antropojenik etki büyük oranda göllere yakın olan alanda belirlenmiştir, (5) peyzaj yapısına bağlı olarak mümkün olduğunca fazla parametrenin kullanılması alanın çok yönlü olarak analiz edilmesini sağladığı gibi analizin hassasiyetini de arttırmıştır.

Anahtar Kelimeler: Peyzaj planlama, doğa koruma, restorasyon, ekolojik değer, arazi kullanımı

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Address for Correspondence:
Simay Kırca
e-mail:
simay@istanbul.edu.tr

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INTRODUCTION

The overuse of natural resources degrades natural habitats, while it may cause the fragmentation and even loss of living areas (Andren, 1994; Harrison and Brauna, 1999; Fahrig, 2003). These alterations have a direct effect on landscape structure (Robinson et al., 1992; Haila, 2002; Lindenmayer et al., 2003) and may manifest themselves with various changes in plant and animal communities (Watt, 1947; Symstad et al., 1998; Villard et al., 1999). Forests are accepted as one of the important natural habitats subject to nature conservation and restoration owing to the rich biodiversity they contain (Enoksson et al., 1995; Scherzinger, 1996; Carr, 1999; Lindenmayer et al., 2006).

Turkey has been known as a country containing diverse natural and cultural landscapes scattered into three phytogeographical regions (Davis, 1979), while 26% of the country is covered with forests. Although these forests have been continuously affected by anthropogenic uses through history (Thirgood, 1987; Perlin, 1989; Kehl, 1995; Rackham and Moody, 1996), they still remain reasonably intact and various vegetation types represent differences in floristic diversity including climate, geology, topography, soil structure and endemism (Çolak et al. 2010). Currently, about 8.10% of the country's land surface is designated as protected areas (Anonymous, 2002-2013) (40 national parks, 31 nature conservation areas, 203 nature parks, 112 nature monuments, 81 wildlife conservation areas, 16 special environmental protection areas, 14 Ramsar sites and 1 biosphere reserve), which mainly focus on forests, wetlands and mountain habitats (DKMPGM, 2015). However, there are serious concerns about the planning and management of protected areas globally, that they turn into "paper parks" in a while (Mulongoy and Chape, 2004). Research show that only 25% of protected forest landscapes are planned and managed properly and only 1% are safe in the long term (Secreteriat of the Convention on Biological Diversity, 2004). Main threats on the protected areas are determined as direct anthropogenic effects (e.g. habitat fragmentation, urbanization, development of infrastructure, mining, recreational activities, over-grazing, hunting, etc.), socio-political and economic factors (e.g. lack of political support, insufficient financial resources and employees, lacking or ineffective nature conservation policies, negative approach of local people, etc.) and flaws and deficiencies of management (lack of strategic plans, human resources and budget plans, poorly handled management plans, etc.) (Hockings et al., 2000; Nolte et al., 2010). These concerns are also valid for Turkey, while Kurdoğlu and Çokçalışkan Avcıoğlu (2011) stated that there are serious problems in the development of basic management processes like planning, organization, coordination and control in most protected areas. The threats are mainly lacking of a well-defined protected area management system, inadequate technical experts, inconsistency with the international nature conservation system, mass tourism and pollution (Kuvan, 2012). According to Yücel and Babuş (2005) these are caused by poorly designed education programmes, legal gaps, difficulties in collecting data and particularly inappropriate land use. On the other hand, in the legal definition of national park in the National Parks Law No.2873 (Article 2) it has been stated that these are "parts of nature containing recreational and tourism areas". This has resulted with perceiving tourism development as a precondition of protected area design followed by inappropriate land use types, facilities and infrastructure (Yücel, 2005).

Ecological value analysis has been widely used in landscape planning studies, selection of nature conservation sites and their planning as well as species conservation programmes in the European and North American countries since 1960s in order to prevent aforementioned conflicts (e.g. Sukopp, 1970, 1971; Montag, 1976; von Haaren, 1980; Ammer et al., 1981; Ammer and Utschick, 1984; Wrbka et al., 2005; Stewart and Neily, 2008; Bradtka et al., 2010). State of the ecosystems and landscapes are analysed and assessed by considering their quantifiable characteristics such as; naturalness, rarity, integrity, functionality, stability, etc. The main motivation of using this method is to describe natural systems formed as a result of intertwined complex processes with their prominent features and determine their "ecological value" (Geyler, 2008). Although many parameters may be used for determining ecological value, they are mainly grouped under 3 categories as; (1) ecosystem-based parameters, (2) population- and particularly species-based parameters, and (3) anthropogenic-based parameters (Ammer and Utschick, 1984), parameters are selected due to the general characteristics of the site and planning goals (Wulf, 2001).

Considering the aforementioned problems and approaches, the main question "What to conserve/restore?" was tried to be addressed in order to (1) develop a new planning concept for determining nature conservation and restoration priority areas based on the basic principles of ecological value analysis and (2) develop a concept that can be changed and transformed according to the needs of different landscape types.

MATERIALS AND METHODS

Study Area

Yedigöller National Park (Bolu), which was selected as study area in this study, is located in Western Black Sea Region in Bolu between 31°44'-31°47' eastern longitudes and 40°55'-40°58' northern latitudes (Figure 1). The area was announced as national park in 1965 with the reason "presence of mixed forest plants as a whole in the same region" covering an area of 1631 ha and contains seven avalanche lakes. The altitude changes from 490 m to 1298 m. It lies within the northeastern euxin forest zone (Mayer and Aksoy, 1998) and mainly contains pure Oriental beech and a small amount of pure oak stands. The national park is also composed of mixed stands such as beech-fir, beech-oak, beech-oak-Black pine, beech-Black pine, beech-Black pine-Scots pine-fir, beech-Black pine-Scots pine, oak-beech, oak-Black pine and Black pine-oak stands. According to Tokcan (2015) there are 3 main plant communities (*Erica arborea-Quercus petraea, Rhododendron ponticum-Fagus orientalis* and *Fagus orientalis-Abies bornmülleriana*) and 7 sub-communities, while totally 202 taxa were determined in the study area from which 10 are endemics. Yedigöller National Park hosts annually 160 000 visitors in average mainly from April to November (Bolu Regional Directorate of Forestry 2017, oral. comm.). Most preferred recreational activities are picnicking, camping, trekking, photographing and line fishing, while these are mainly concentrated around lakes. Other focal sites in the park are monumental Black Pine and Kapankaya Panoramic Terrace (Figure 1).

Methods

The methodology used in the study basically contains the analyses performed in "ecological value analysis" and is composed of five main steps as; (1) selecting parameters as a base for the analyses, (2) generating data bases and base maps suitable for the parameters, (3) performing the analyses, (4) assessment and results, (5) preparing the map of nature conservation and restoration priority areas. In this study "biology and ecology based parameters" and "parameters based on various structural features of the forest" were selected in order to reflect the natural and cultural characteristics of the area instead of classical base maps such as slope, aspect, elevation, soil types, stand types and general flora and fauna lists. Ecological value analysis was performed with the assessment of 16 parameters under 4 main parameters, which are (1) naturalness (hemeroby degrees), (2) rarity (rarity of sub-plant communities and their aerial size, rarity of taxa in country and regional level and endemic taxa), (3) structural diversity (stand layerness, age, mixture type, mixture rate, canopy closure, number of biotope trees and their DBH -diameter at breast height-, deadwood amount, patch number of sub-plant communities and (4) species richness (number of tree, shrub and herbaceous taxa). These parameters were analysed by using relation matrices and direct scoring.

Sampling Design

Present base maps (hemeroby map and the map of sub-plant communities; Tokcan, 2015) and databases (Western Black Sea Forestry Research Institute GIS database) as well as the data gathered by field studies from totally 80 sample plots in two different levels were used in the analyses. Data related to stand structure and small structures were collected from 60 sample plots determined as the corner points of 1 km x 1 km UTM grid network from the whole area. All sample plots were non-randomly selected and sampling design follows the methodology used in hemeroby mapping in order to adapt data collected with field studies to the present maps and databases easily. Small structures (biotope trees and deadwood) were also determined in an area of nearly 300 m^2 as is applied in hemeroby mapping methodology (Grabherr et al., 1998) (Figure 2).

20 additional sample plots of 200 m x 200 m were identified around lakes in order to determine hemeroby degrees (degree of human influence on the natural environment; Grabherr et al., 1998) and sub-plant communities around lakes in detail, since anthropogenic use is mainly concentrated in this part of the park (Figure 2).

Data Assessment

Gathered data from 60 sample plots related to stand structure and small structures were first classified in a Microsoft Excel database file. Data related to sub-plant communities were also classified in a Microsoft Excel database and then assessed in JUICE program, while hemeroby data were first classified in Microsoft Access database and analysed in "hemprog" program. Maps of each parameter used in ecological value analysis were

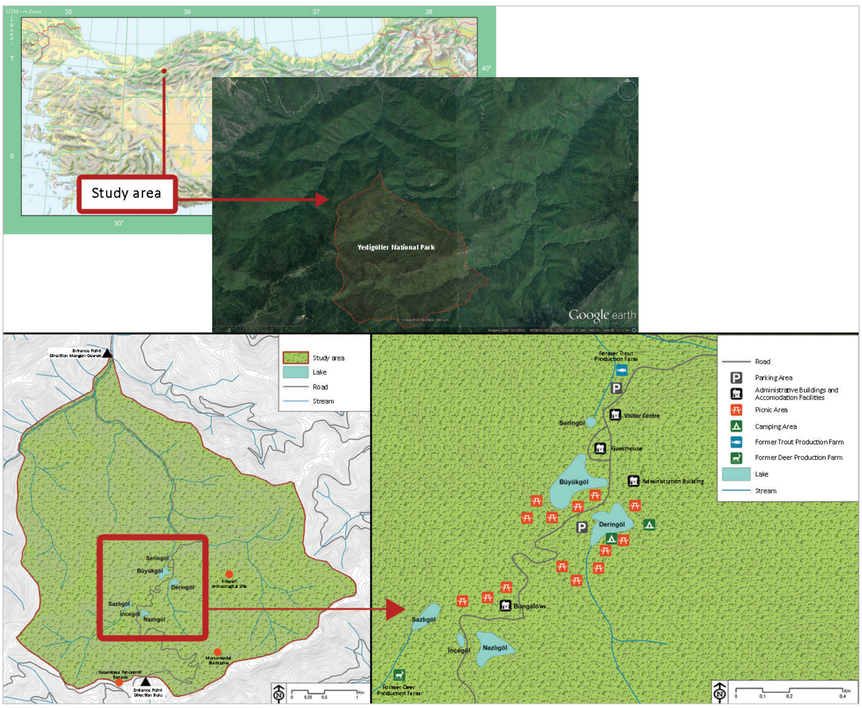

Figure 1. Location of the study area and main focal sites

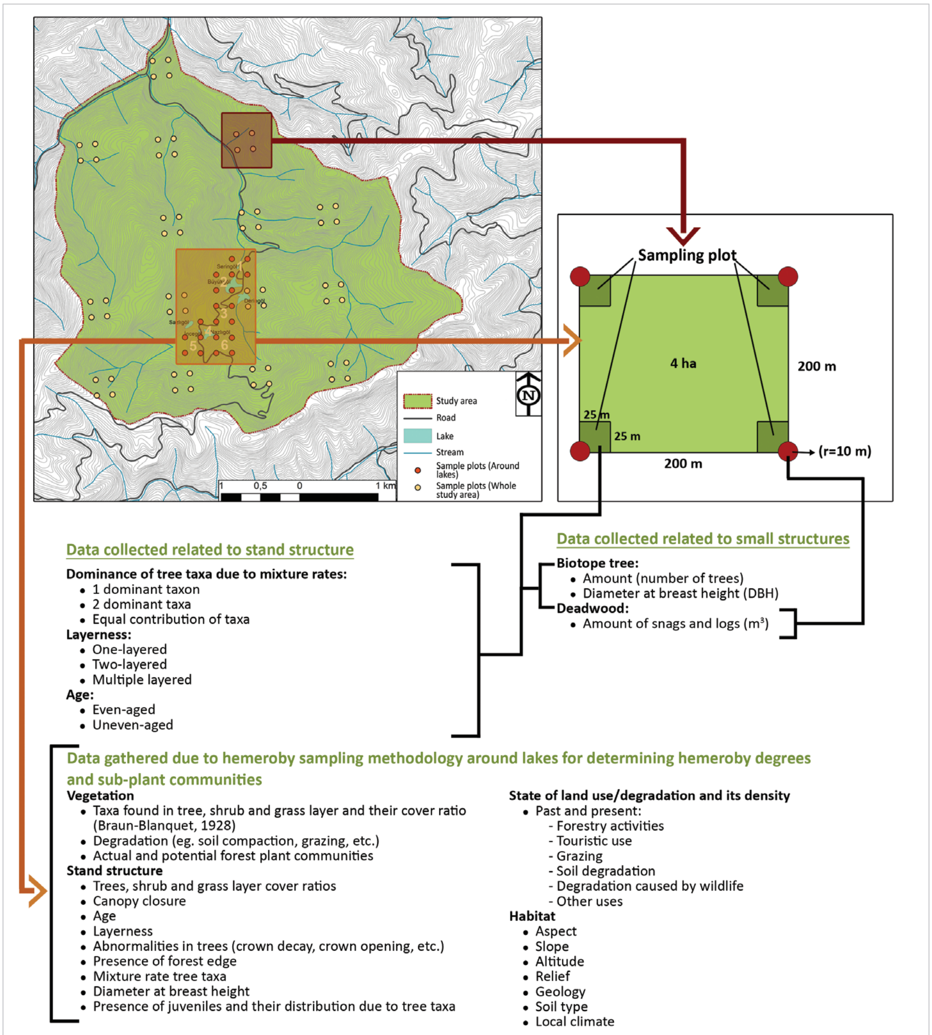

Figure 2. Sampling design to collect data related to stand structure and small structures as well as hemeroby degrees and sub-plant communities around lakes

prepared by taking the Yedigöller National Park Forest Stands Map as a layout and processed in ArcGIS 10.2 software.

The methodology in data assessment basically follows the general principles of the studies of Ammer and Utschick (1982, 1984), Stoffel (1992), Bastian et al. (2002) and Wrbka et al. (2007) (for detailed information, see Kırca, 2015). Following the preparation of the layout maps for ecological value analysis, parameters were classified as; (1) main parameters and (2) correction parameters. Main parameters were combined within each other with logical combination (S_1 to S_6 as shown in Figure 3) based on current literature and parameters were weighted due to their priority and importance identified according to the aims of the research as well as current knowledge (for S_1: i.e. Ammer and Utschick, 1982; Jefferson and Usher, 1986; Usher, 1986; Dzwonko and Loster, 1989; Verkaar 1990; Gaston, 1994; Idle, 1994; Kirby, 2004; Ploeg, 1994; Wulf, 1997; Wrbka et al., 2007 - for S_2: i.e. Preston, 1962; Schwartz and Simberloff, 2001; Gaston, 1994; Rodrigues and Gaston, 2002 - for S_3: i.e. Ammer and Utschick, 1982; Kirby, 2004; Honnay et al., 1999 - for S_4: i.e. Petermann and Seibert, 1979; Leibundgut, 1983; Duchiron, 2000; Gamfeldt et al., 2013 - for S_5: i.e. Ammer and Utschick, 1982; Atay, 1984; O'Hara, 1998, 2006; Çolak and Asan, 2010; Kerr et al., 2014 - for S_6: i.e. Winter et al., 2003; Hahn et al., 2005; Gürlich, 2009; Niedermann-Meier et al., 2010). Logical relation matrices were created for the combined parameters and scores from each combination were summed in order to calculate the nature conservation and restoration score (Figure 3).

Correction parameters were also combined with each other with logical combination (for C_1: i.e. Usher, 1994; Forman, 1995; Opdam et al., 1995; Gyllenberg and Hanski, 1997; Barsch et al., 2002; McGarigal, 2002; Piassens et al., 2004 and for C_2: i.e. Levins, 1969; Kareiva, 1990; Taylor, 1990; Hanski and Gilpin, 1997; Hanski, 1999; McGarigal, 2002) but also with direct scoring (for C_3: i.e. Jedicke, 1997; Kerr, 1997; Médail and Verlaque, 1997; Berg, 2001; Anderson, 2002; Brigham and Schwartz, 2003; Berg et al., 2008; Hampicke, 2013; Wittig and Niekisch, 2014 and for C_4: i.e. Prietzel, 1994; Grabherr et al., 1998; Vallauri et al., 2003; Hahn and Chris-

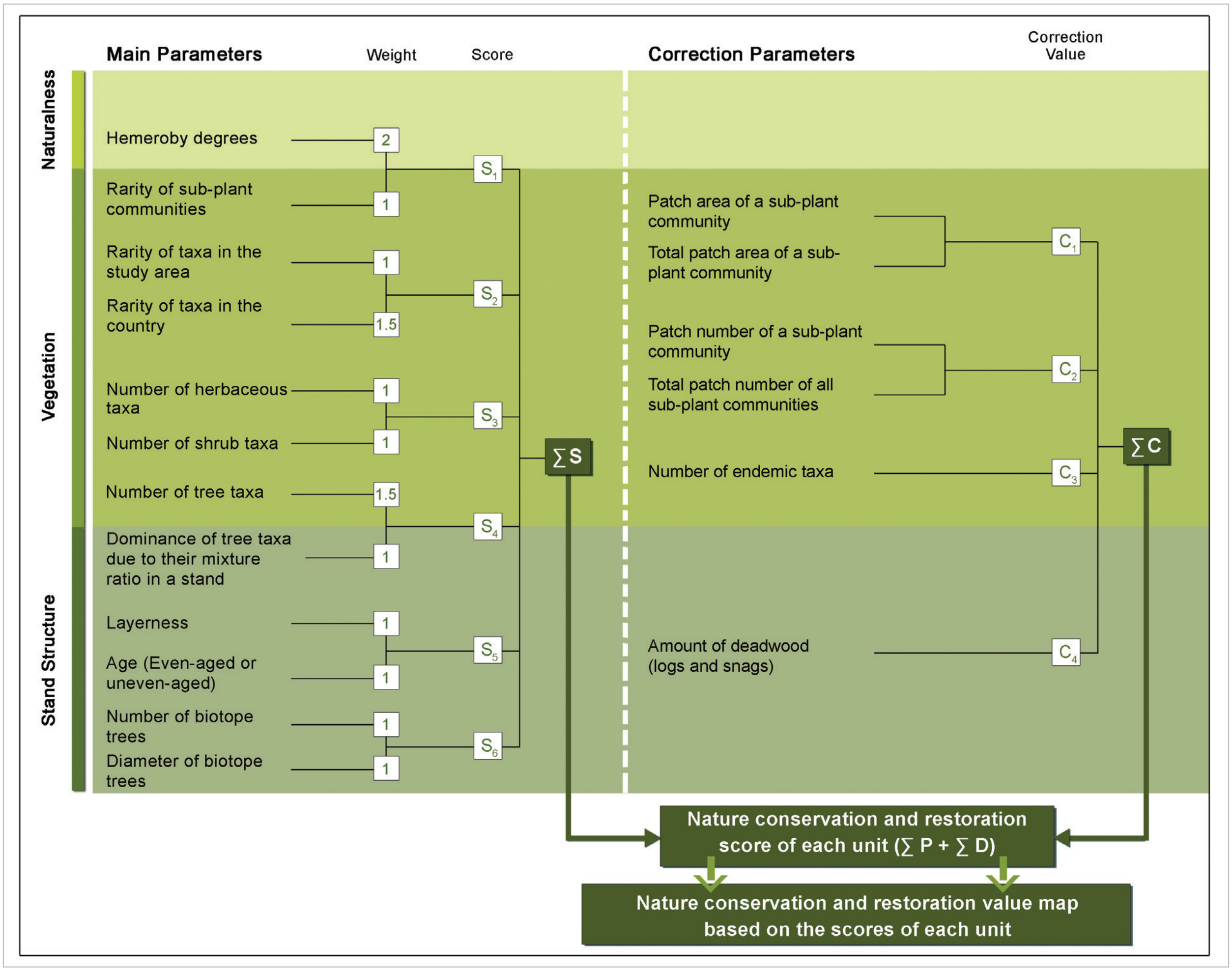

Figure 3. Methodology used for the calculation of nature conservation and restoration value in Yedigöller National Park

tensen, 2005; Çolak et al., 2011). Logical relation matrices were created for the combined parameters, while correction tables were created for the parameters assessed with direct scoring. As a result scores were summed and nature conservation and restoration value map was prepared as illustrated in Figure 4.

Maps of each parameter were transformed from vector maps to raster maps with a pixel resolution of 2 m x 2 m (unit) in order to calculate the nature conservation and restoration score of each unit. Then values in each unit were summed for the preparation of nature conservation and restoration value map in ArcGIS 10.2 (Figure 4).

RESULTS

The results of the assessment of main and correction parameters as well as nature conservation value map are given below.

Main Parameters

Hemeroby Degrees-Rarity of Sub Plant Communities

The detailed hemeroby analysis around the lakes revealed that hemeroby degrees range between β-euhemerob (3-far from natural) to ahemerob (9-natural). Together with the general hemeroby map (Tokcan, 2015), 0,3% of Yedigöller National Park was determined as β-euhemerob (3-far from natural), while 0,4% as α-mesohemerob (4-relatively far from natural), 0,2% as β-mesohemerob (5-relatively far from natural), 6.9% as α-oligohemerob (6-relatively far from natural), 6.8% as β-oligohemerob (7-semi-natural), 62.2% as γ-oligohemerob (8-close to natural) and 23.2% as ahemerob (9- natural) (Figure 5a).

Two sub plant communities were determined around the lakes as; (1) *Erica arborea-Quercus petraea/Pinus nigra* sub-community and (2) *Carpinus betulus* sub-community. After combining the map of sub plant communities of Tokcan (2015) with the results of this study, rarity degrees of *Erica arborea-Quercus petraea/ Pinus nigra* sub-community of *Erica arborea-Quercus petraea* community, typical sub-community and *Pinus nigra* sub-community of *Rhododendron ponticum-Fagus orientalis* community were found as "very common", while typical sub-community of *Erica arborea-Quercus petraea* community, *Carpinus betulus* sub-community of *Rhododendron ponticum-Fagus orientalis* community and typical sub-community of *Fagus orientalis-Abies bornmülleriana* community were found as "rare" and *Pinus syl-*

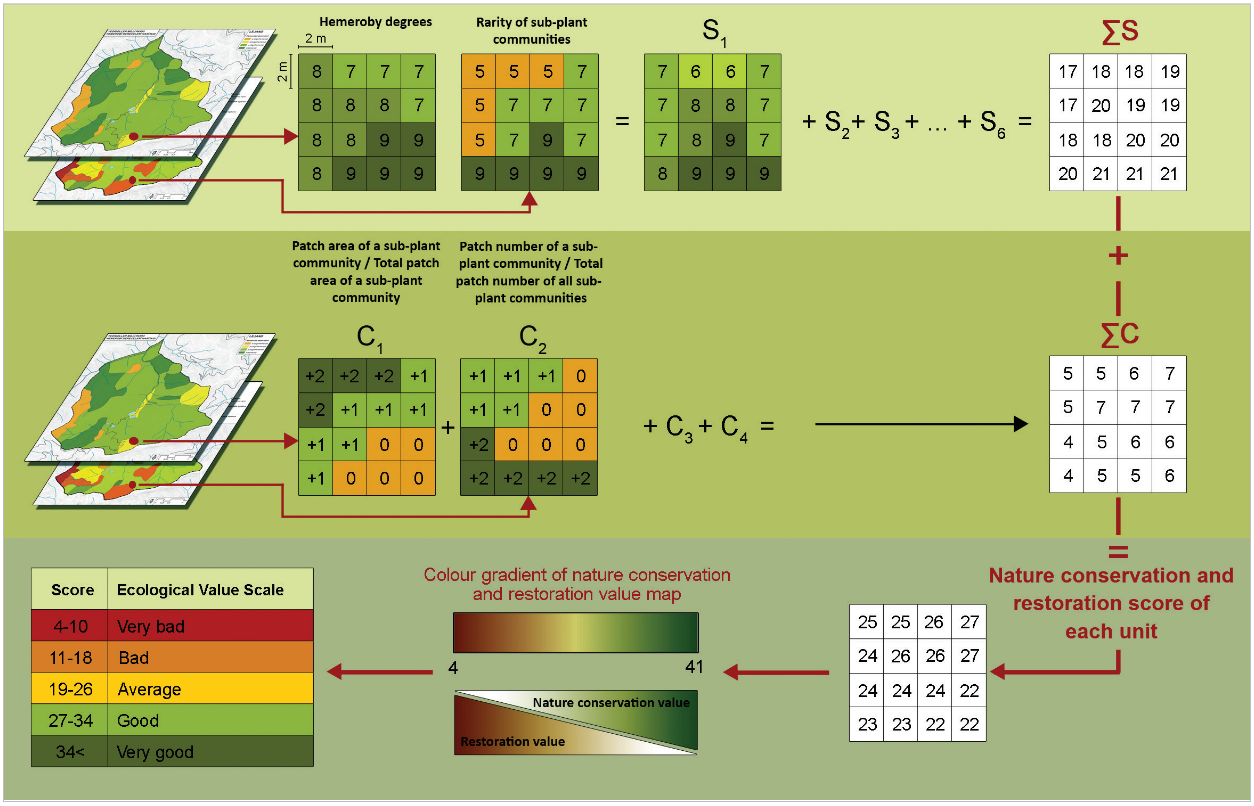

Figure 4. Steps followed by the preperation of nature conservation and restoration value map

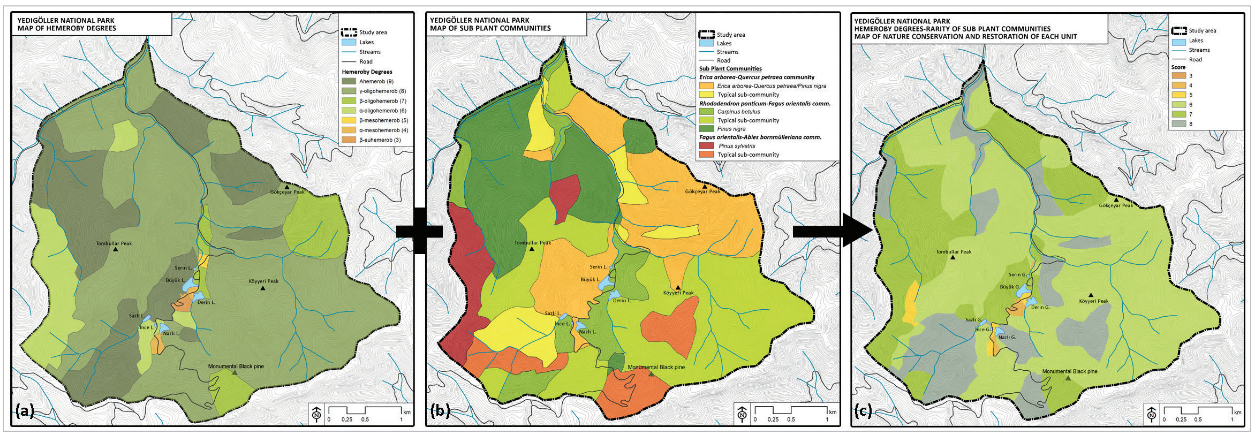

Figure 5. a-c. Yedigöller National Park (a) Map of hemeroby degrees, (b) Map of sub plant communitites and (c) Map of nature conservation and restoration score of each unit

vestris sub-community of *Fagus orientalis-Abies bornmülleriana* community was found as "very rare" (Figure 5b).
The resulting map in Figure 5c shows the nature conservation and restoration scores ranging between 3 to 8.

Rarity of Taxa in the Study Area-Rarity of Taxa in the Country
Totally 224 plant taxa determined in the study area were classified into 4 groups according to their rarity in the study area, while 3.8% (8 taxa) of the taxa were grouped as very common, 13.9% (31 taxa) as common, 33.8% (75 taxa) as rare and 48.5% (108 taxa) as very rare. These taxa were represented in 5 groups due to their presence in the sample plots in Figure 6a. According to this map, rarity rate "very rare taxa 2≥ " has the greatest share with 33% (529.26 ha). It is followed by "very rare taxa 2< " with a share of 29% (466.51 ha), "rare taxa 2< " with a share of 25% (411.35 ha), "common taxa" with a share of 7% (118.06 ha) and "rare taxa 2≥ " with a share of 6% (100.1 ha).

Unlike the rarity rates of taxa in the study area, 30.4% (68 taxa) and 63.8% (143 taxa) of 224 taxa were determined as very com-

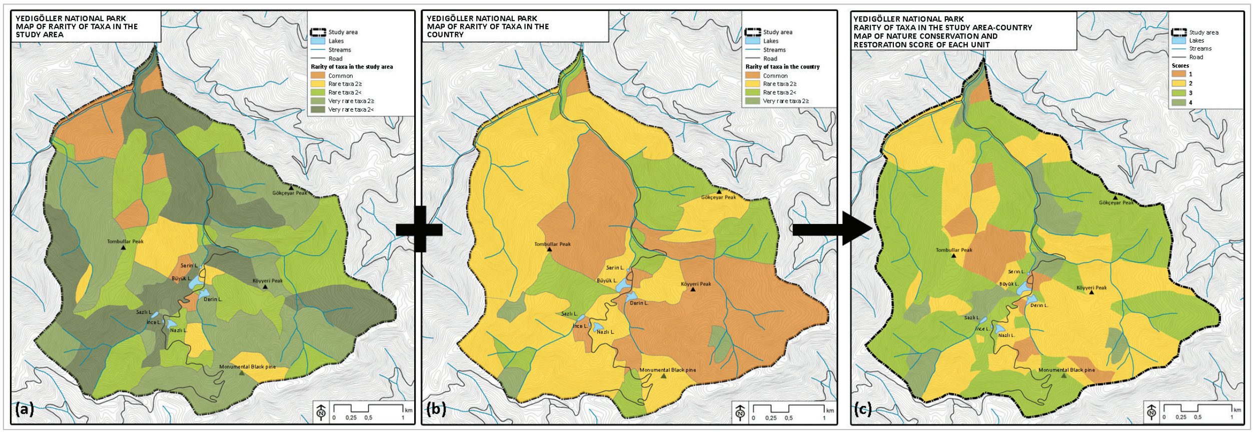

Figure 6. a-c. Yedigöller National Park (a) Map of rarity of plant taxa in the study area, (b) Map of rarity of plant taxa in the country and (c) Map of nature conservation and restoration score of each unit

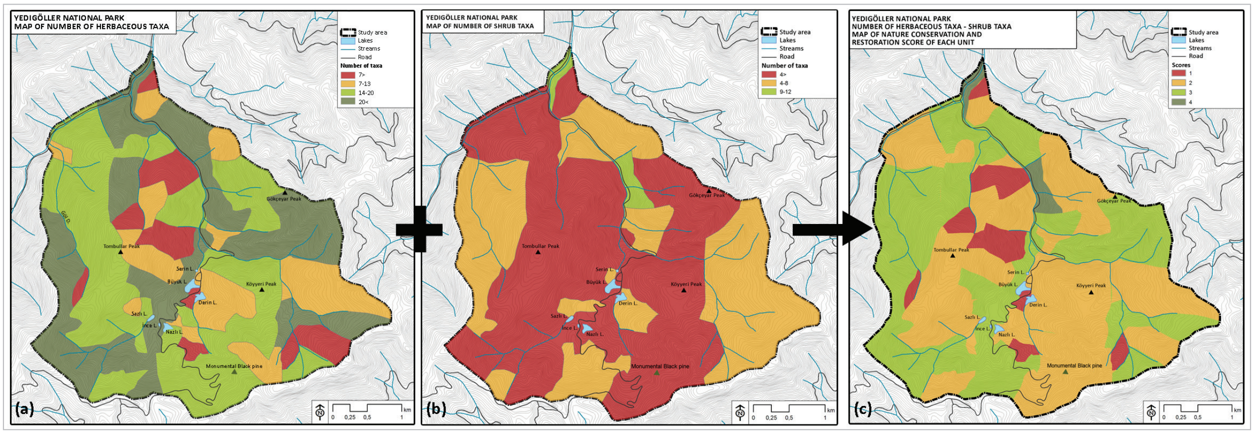

Figure 7. a-c. Yedigöller National Park (a) Map of number of herbaceous taxa, (b) Map of number of shrub taxa and (c) Map of nature conservation and restoration score of each unit

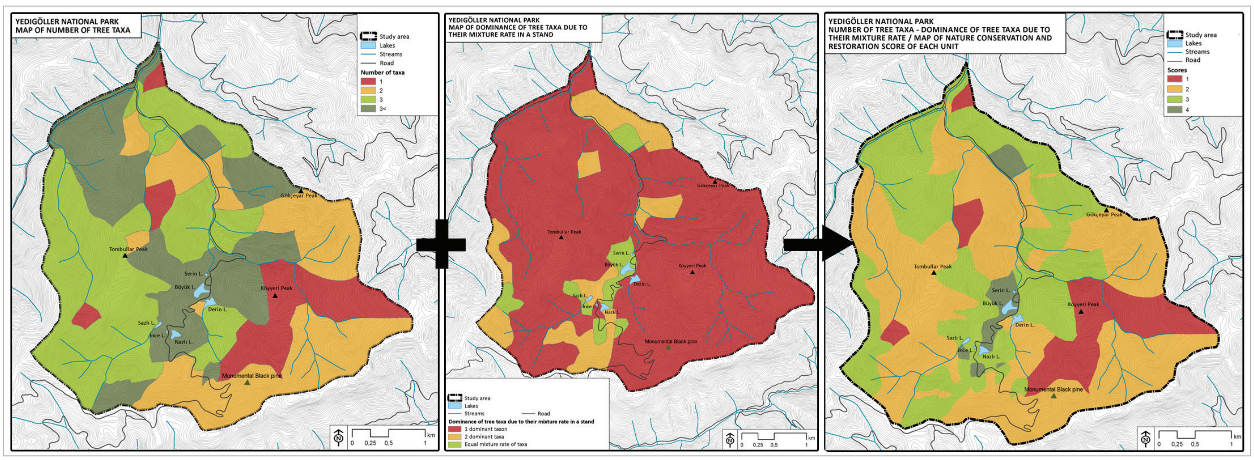

Figure 8. a-c. Yedigöller National Park (a) Map of number of tree taxa, (b) Map of dominance of tree taxa due to their mixture rate in a stand and (c) Map of nature conservation and restoration score of each unit

mon and common in the whole country, respectively. Only 4.9% (11 taxa) of the taxa were grouped as rare and 0.9% (2 taxa) as very rare. These taxa were represented in 4 groups due to their presence in the sample plots. According to the map (Figure 6b),

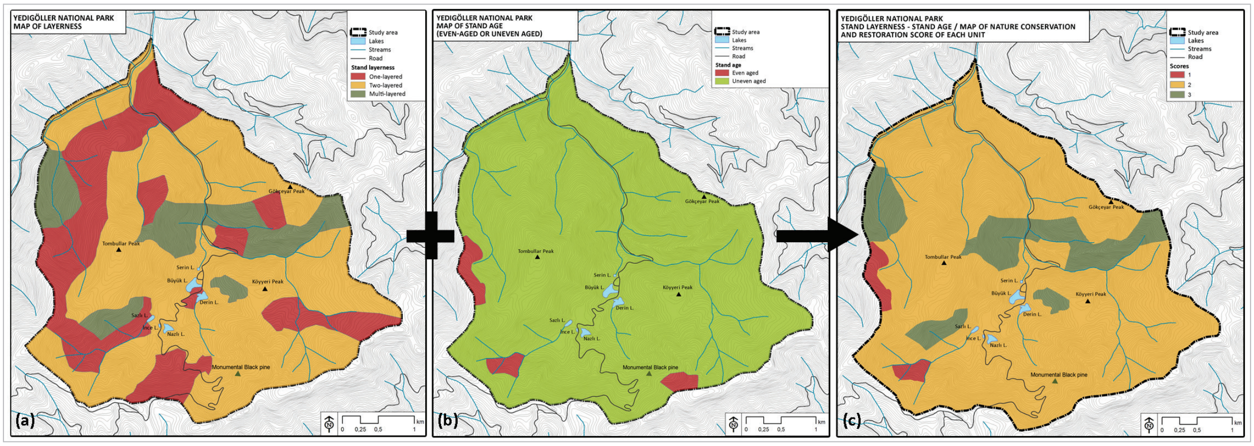

Figure 9. a-c. Yedigöller National Park (a) Map of layerness, (b) Map of stand age (even-aged or uneven aged) and (c) Map of nature conservation and restoration score of each unit

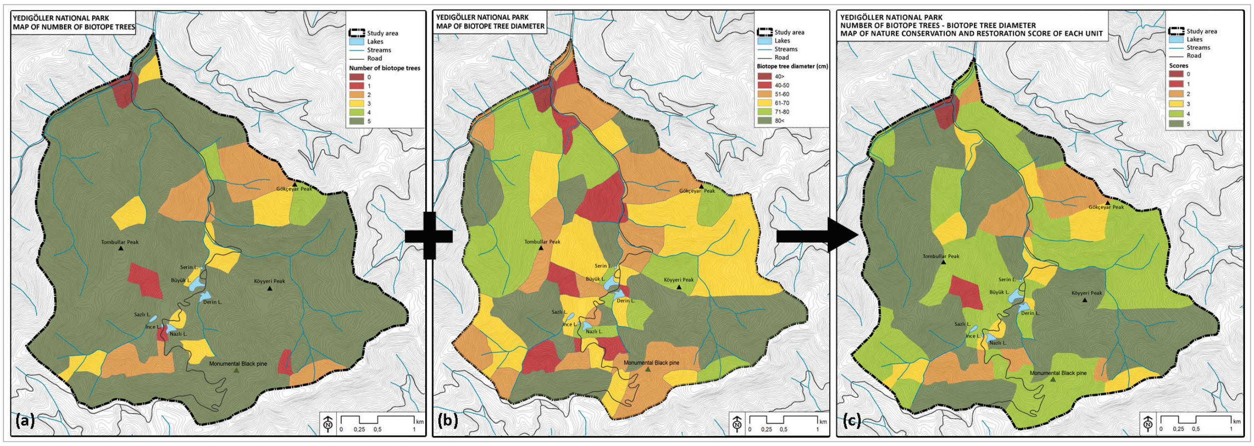

Figure 10. a-c. Yedigöller National Park (a) Map of number of biotope trees, (b) Map of biotope tree diameter and (c) Map of nature conservation and restoration score of each unit

rarity rate "rare taxa 2≥ " has the greatest share with 47% (769.44 ha). It is followed by "common" with a share of 35% (559.14 ha), "rare taxa 2< " with a share of 16% (264.25 ha) and "very rare taxa 2≥ " with a share of 2% (32.45 ha) (Figure 6b).

The resulting map in Figure 6c shows the nature conservation and restoration scores calculated according to the rarity of taxa in the study area and in the country ranging from 1 to 4.

Number of Herbaceous Taxa-Number of Shrub Taxa

Herbaceous taxa were classified into 4 groups due to their presence in the sample plots. Accordingly, number of herbaceous taxa is 7> in 9% (141.94 ha) of the area, while it is 7-13 in 17% (279.82 ha), 14-20 in 40% (654.22 ha) and 20< in 34% (550.04 ha) (Figure 7a).

Number of shrub taxa was represented with 3 groups, which are 4> in 60% (975.47 ha), 4-8 in 38% (618.92) and 9-12 in 2% (31.1 ha) of the study area (Figure 7b). The final map in Figure 7c shows the distribution of nature conservation and restoration scores ranging between 1 and 4.

Number of Tree Taxa-Dominance of Tree Taxa Due to their mixture Rate in a Stand

Tree taxa were classified into 4 groups due to their presence in the study area. As a result, 1 tree taxa was found in 12% (186.96 ha) of the study area, while 2 taxa was found in 26% (426.54 ha), 3 taxa in the 35% (586.66 ha) and 3< in 27% (443.51 ha) of the study area (Figure 8a).

In 83% (1346.79 ha) of the study area 1 tree taxa is dominant. Rest of the stands are composed of either 2 dominant tree taxa (12%-204.33 ha) or equal mixture of tree taxa (5%-74.38 ha) as shown in (Figure 8b). The resulting map in Figure 8c shows the nature conservation and restoration scores ranging from 1 to 4.

Layerness-Age

The results show that 26% (418.16 ha) of the study area is composed of one-layered stands, while 61% (998.76 ha) of two-layered stands and 13% (208.57 ha) of multi-layered stands (Figure 9a). On the other hand, 97% of the area is composed of uneven-aged stands and 3% (43.29 ha) of even-

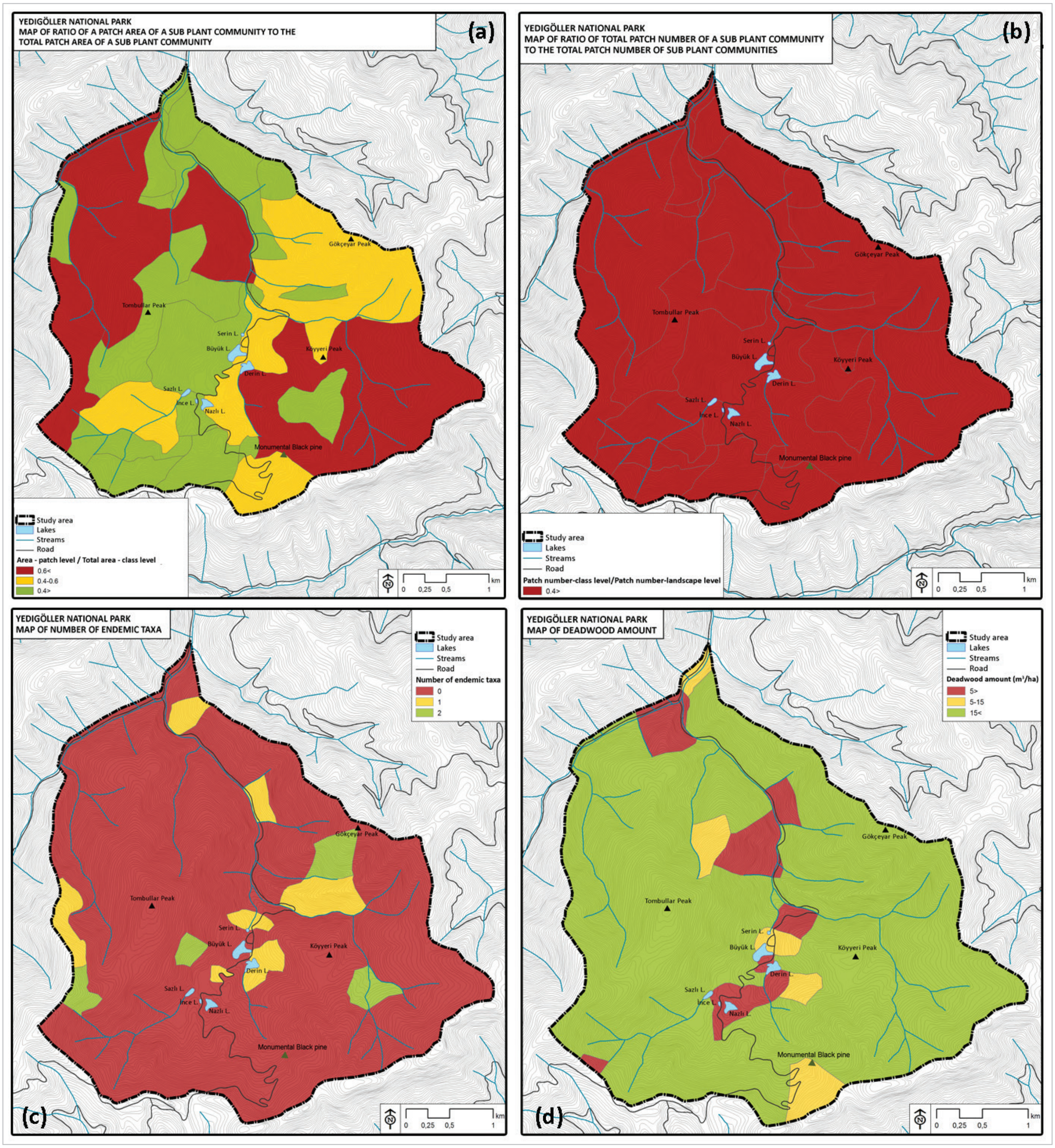

Figure 11. a-d. Yedigöller National Park (a) Map of ratio of a patch area of a sub plant community to the total patch area of a sub plant community, (b) Map of ratio of total patch number of a sub plant community to the total patch number of sub plant communities, (c) Map of number of endemic taxa and (d) Map of deadwood amount

aged stands (Figure 9b). The final map shows the distribution of nature conservation and restoration scores ranging from 1 to 3 (Figure 9c).

Number of Biotope Trees-Diameter of Biotope Trees

In 82% (1329.44 ha) of the study area 5 biotope trees were found. Rest of the area mainly contains 2 (8%-134.86 ha) or 3 (6%-93.71 ha) biotope trees as shown in Figure 10a. Diameter of biotope trees in the study area were classified under five groups, while tree diameter class of 80 cm< covers 27% (444.76 ha) of the study area. Diameter class of 71-80 cm was found in 22% (352.76 ha), 61-70 cm in 24% (384.04 ha), 51-60 cm in 20% (329.8 ha), 40-50 cm in 6% (101.02 ha) and 40 cm> in 1% of the study area (Figure 10b). The resulting map in Figure 10c shows the nature conservation and restoration scores ranging from 1 to 5.

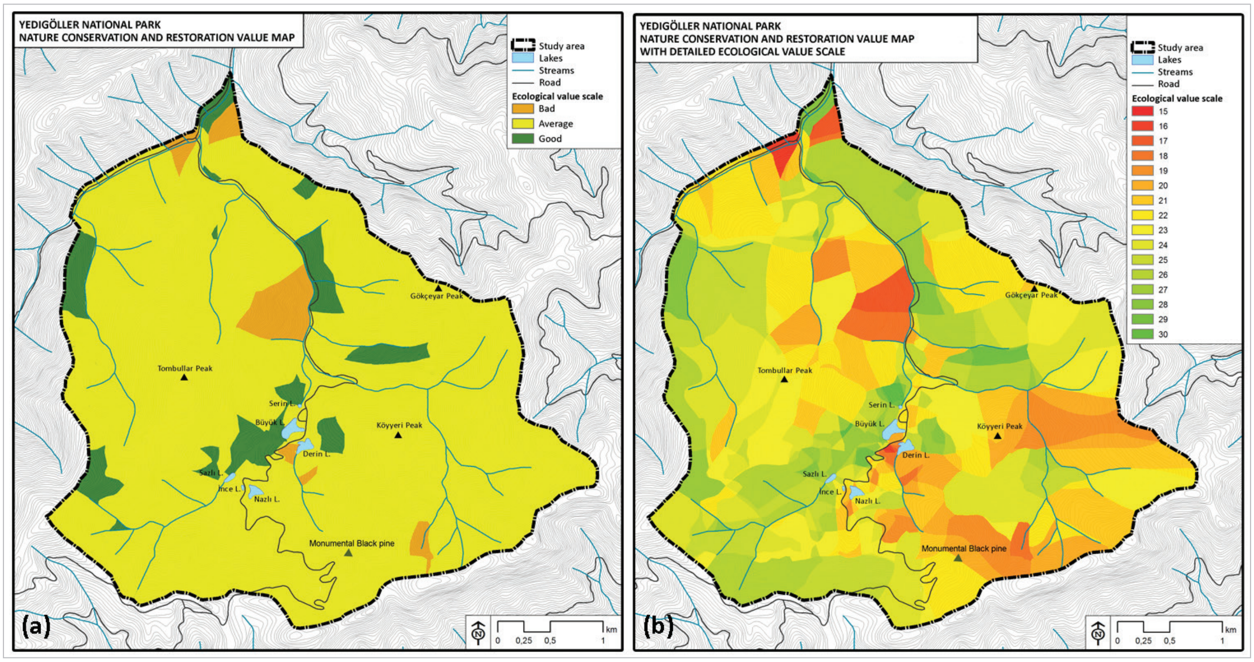

Figure 12. a, b. Yedigöller National Park (a) Nature conservation and restoration value map and (b) Nature conservation and restoration value map with detailed ecological value scale

Correction Parameters

The results of the ratio of a patch area of a sub plant community to the total patch area of a sub plant community were classified in 3 groups. The areas with a ratio of 0.6< cover 35% (574.05 ha) of the study area, which have the lowest ecological value. The areas with a ratio of 0.4-0.6 cover 23% (376.29 ha) of the study area, while the areas with highest ecological value represented with 0.4> cover 42% (675.24 ha) of the national park (Figure 11a).

Only 1 group was determined as the ratio of total patch number of a sub plant community to the total patch number of sub plant communities, which is 0,4> (Figure 11b). On the other hand, 8 endemic taxa were detected in the study area and were classified due to their presence in sample plots. As a result, 2 endemic taxa in 4% (60.37 ha) and 1 endemic taxon were found 6% (102.69 ha) of the study area (Figure 11c). Finally the amount of deadwood was found as 15< m^3/ha (highest ecological value) in 87% (1423.8 ha) of the study area, while areas with 5-15 m^3/ha and 5> m^3/ha have a smaller share of 5% (77.07 ha) and 8% (124.62 ha), respectively (Figure 11d).

Nature Conservation and Restoration Map

As a result of the assessment of main and correction parameters, 3 ecological value classes were determined as "bad", "average" and "good". 90% (1463.6 ha) of the study area was characterised as average, while 6% (105.13 ha) as high and 4% (56.76 ha) as bad as shown in Figure 12a. However, ecological value scores were given in detail in Figure 12b ranging between 15 and 30.

RESULTS AND DISCUSSION

Ecological value analysis has been widely applied in concepts generated by selecting suitable site-specific parameters since years particularly in western countries in landscape planning as well as selection and planning of nature conservation areas (Sukopp, 1970, 1971, 2004; Wilmanns et al., 1978; Marks, 1979; Von Haaren et al., 1980; Ammer et al., 1981; Ammer and Utschick, 1982; Stoffel, 1992; Alonso and Falero, 1995; Czeranka and Peithmann, 1997; Bastian, 1999; Brändli, 2001; Wrbka et al., 2005; Stewart and Neily, 2008; Bradtka et al., 2010). In this study parameters have been selected considering the general ecological character of the area and following suggestions related to ecological value analysis have been made:

Ecological value analysis may be applied in small scale (Ammer and Utschick, 1982), as well as in country scale (Wrbka et al., 2005). Thus, selection of parameters used in the analysis should be performed with great care. On the other hand, usual data layers like slope, aspect, altitudinal classes, soil types, stand types and general flora and fauna lists are generally used in many landscape planning practises applied in forest areas in Turkey. However many biological based important parameters have either not been used or the relation between them has been merely recognised. On the contrary, stands regarding the parameters commonly used in the studies among Europe, selected parameters are mainly based on the biological and ecological characteristics of the study area as well as various qualities of the forest. Therefore, a wide range of parameters were used related to naturalness, vegetation and stand structure in order to develop a site-specific and multidimensional analysis methodology in this study. As in this study, numerous new parameters may be used in ecological value analyses applied in forests, while they should be regarded as replaceable tools by new parameters and matrices may be easily modified and adapted to different situations. Some layouts used in this study, i.e. map of hemeroby degrees and plant societies, contains biological and ecological sub-parameters which strengthen the results of the analysis. In many studies it is highly recommended to use much parameters as possible as the landscape structure gets complicated (Braun-Blanquet, 1964; Margules et al., 1991; Riedel and Lange, 2002; von Haaren, 2004; Lindenmayer et al., 2006). Thus, use of such maps (e.g. biotope maps) are highly recommended in further analyses.

The results of ecological value analysis applied in Yedigöller National Park were presented in two different ways. The general framework of planning decisions may be rapidly formed by using both of those result maps (Figure 12), whch provide a more clear picture about the ecological value of the area. On the other hand, maps of each parameter (Figure 5-11) provide detailed knowledge and database on the landscape and may be used as supportive layouts by taking specific decisions as well as during the monitoring process after planning.

In this study, parameters were combined with logical relation matrices and weighted due to the literature on landscape ecology and landscape analysis as in Wrbka et al. (2005). Each group of parameter has been accepted to carry equal importance for nature conservation. Methods of multi-criteria decision making processes like Analytical Hierarchy Process, PROMETHEE, ELECTRE, etc. may be used in further studies in order to assess the differences in results of various methods.

The results of ecological value analysis may be used as layouts for landscape planning studies, however these analyses should be repeated for monitoring the success of the planning and natural dynamics in the long term. For example, in U.S.A. (Oakley et al., 2003) and EU member countries (Leverington et al., 2010) such procedures are repeated every 5-10 years in protected areas.

The forms filled for each sample plot may be used as bases with regard to the selection of suitable techniques in nature conservation and restoration practises to be applied in zones in the required areas and for the monitoring of the implementations in the long term.

Based on the findings of this study a zoning plan may be offered as classifying 65% of the national park as core area. The rest may be specified as buffer zone and transition zone. The following suggestions are offered to be considered when preparing a landscape plan for Yedigöller National Park:

The area of the national park might be broadened by determining alternative attraction points for recreational activities like picnic, camping, trekking, biking, etc. Thus, actual degradation around lakes caused by intensive recreational use would be prevented by creating alternative low-intensity recreational uses.

Further panoramic view terraces might be built in addition to the Kapankaya Panoramic View Terrace located near the south entrance of the area, while visitors would be invited to these points instead of lakes.

Eco-tourism and nature education activities might be promoted on the buffer zone and transition zone of the national park, which may be located on the managed forests around the actual border of the national park, since these forests do also represent the mixed forests characteristic to the region and contain diverse wildlife.

Monumental trees, biotope trees, areas rich in deadwood amount and contain species rich habitats (Beşkardeş, 2010; Anonymous, 2013) may be considered when designing trekking and biking routes in order to allow visitors meet different habitats and learn about their value.

Long-term management plan of the national park should be prepared to cover issues on general structure of the area and predetermined plan targets, nature conservation and forestry activities to be applied in each management zone, species and habitat conservation and restoration activities, uses and permits, infrastructure network, education and public relations, recreation and research opportunities and further details.

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